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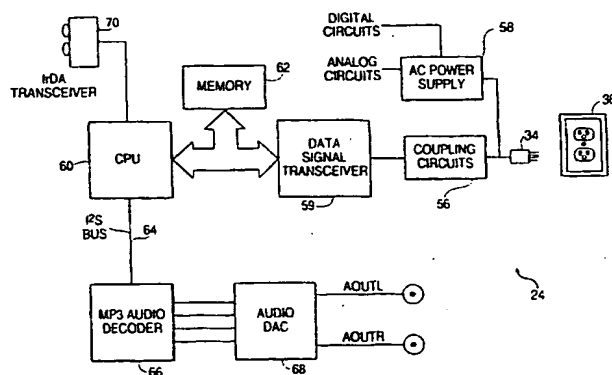
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(54) Title: **DATA POWER LINE NETWORK**



(57) **Abstract:** A data power line network enables data signals, such as music in MP3 format, available on a data bus, to be transported to audio equipment and played, for example, by a conventional stereo system. The data power line network includes a data bus-to-power line interface adapter which provides an interface between a data bus, for example, on a personal computer, and a conventional power line network, such as a 120-volt AC residential power line network. The data bus-to-power line interface adapter interfaces with the power line network as well as modulates and transmits the data signals, such as MP3 signals, over the power line network. The system also includes a power line-to-audio equipment interface adapter. The power line-to-audio equipment interface adapter provides an interface between the power line network and the audio equipment, such as a conventional stereo, and receives and demodulates the signals received over the power line network. The power line-to-audio equipment interface adapter may also contain a digital to analog converter (DAC) for converting the data signals to signals compatible with the audio equipment, such as a conventional stereo system. To facilitate use of the device, the power line-to-audio equipment interface adapter may also be provided with an optional remote control, such as an infrared remote control.

DATA POWER LINE NETWORK

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a data power line network and more particularly to a network which enables digital data signals, such as MP3 compressed music signals, available on a data bus, to be transmitted over conventional power lines, such as a residential 120 VAC power line network, and received by audio output equipment, for example, a conventional stereo system plugged in anywhere to the power line network.

10 Description of the Related Art

Music in MP3 format is becoming an ever popular source of music from the Internet and from compact discs. There are various sources of MP3 music. Exemplary MP3 music websites are currently available at the following website addresses: 2Look4; MP3now.com; and MP3.box. Such MP3 music is amenable to being stored on a hard drive or a compact disc on a personal computer and played by the personal computer by way of any number of software decoders, currently available on the Internet. Even though the music in MP3 format provides near CD quality sound with relatively small file sizes, the audio quality from a sound system in a personal computer leaves a lot to be desired. As such, a whole industry has emerged marketing MP3 music players. For example, various companies including Diamond Multimedia have developed portable MP3 players. These portable MP3 players play music stored in MP3 format from various types of digital storage media. In addition, MP3 players are known which enable MP3

stored music files to be transmitted wirelessly from a personal computer to a conventional stereo. An example of such a system is currently available from a company by the name of X10. Unfortunately, such wireless systems are known to have a limited range and also can be relatively noisy. As such, there is a need for
5 MP3 music player which enables MP3 music to be played on a home stereo which has an improved range and better audio quality than known wireless systems.

SUMMARY OF THE INVENTION

Briefly, the present invention relates to a data power line network. The data power line network includes a data bus-to-power line interface adapter which
10 provides an interface between a data bus, for example, on a personal computer (PC), and a conventional power line network, such as a 120-volt AC residential power line network. The data bus-to-power line interface adapter interfaces with the power line network as well as modulates and transmits the data signals, such as MP3 signals, over the power line network. The system also includes a power line-
15 to-audio equipment interface adapter. The power line-to-audio equipment interface adapter provides an interface between the power line network and audio equipment, for example, a conventional stereo, and receives and demodulates the data signals received over the power line network. The power line-to-audio equipment interface adapter may also contain a digital to analog converter (DAC)
20 for converting data signals, for example, digital music signals, to analog signals suitable for a conventional stereo system. To facilitate use of the device and thus control the data source, the power line-to-audio equipment interface adapter may also be provided with an optional remote control, such as an infrared remote control.

25 These together with other objects and advantages which will be subsequently apparent, reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

30 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the audio power line network in accordance with the present invention.

FIG. 2 is a block diagram of the PC to power line interface adapter in accordance with the present invention.

FIG. 3 is a block diagram of the power line-to-remote device interface adapter in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a data power line network which enables
5 digital data signals, such as digital music or other audio signals in MP3 format, to be transmitted over a power line network, such as a 120-volt AC residential power line network, from a data bus, such as a data bus on a personal computer (PC), to remote audio equipment, such as a stereo system. The system is adapted to enable, for example, digital data signals in MP3 format, stored on either a hard
10 drive or a compact disc, to be transmitted to the audio equipment and played, for example, on a conventional stereo system that can be plugged in anywhere to the power line network. Unlike, known wireless systems in which the range is rather limited and the signals are relatively noisy, the system in accordance with the present invention enables the MP3 music to be played by a conventional stereo
15 plugged in anywhere to the power line network while providing relatively high sound quality.

Although the system in accordance with the present invention is described and illustrated with a USB controller and an I²S bus for use with exemplary MP3 streaming data, the principles of the present invention are applicable to other
20 transport media, such as Ethernet, IEEE 1394, telephone cable, coaxial cable and other media. In addition, even though the invention is described in terms of an application to MP3 data signals, those of ordinary skill in the art will appreciate that the principles of the present invention can also be applied to other data types, such as AC3 over other transport types, such as MPEG 2.

Referring to FIG. 1, an exemplary system in accordance with the present invention is generally identified with the reference numeral 20. The system 20 includes a data bus-to-power line interface adapter 22, a power line-to-audio equipment interface adapter 24 and may contain an optional remote control unit 26, for example, an infrared or wireless remote control unit, for controlling the
30 power line-to-audio equipment adapter 24 by sending a control signal to a remote control receiver included in the power line-to-audio equipment adapter 24.

The data bus-to-power line interface adapter 22 is adapted to connect to a data bus, for example, a universal serial bus (USB) port (not shown), provided, for example, in a personal computer 28. Universal serial buses are known in the
35 art, for example, as illustrated in U.S. Patent Nos. 5,818,948 and 5,845,151, hereby incorporated by reference. Connection between the data bus and the data bus-to-power line interface adapter 22 is by way of, for example, a USB cable 30

and a USB connector. The data bus-to-power line interface adapter also connects to the power line network, for example, by way of a conventional AC plug 33 that is adapted to be plugged into a conventional 120 VAC receptacle 35 (FIG. 2).

5 The power line-to-audio equipment interface adapter 24 enables audio equipment, for example, a stereo, to be plugged in anywhere to the power line network, to receive and play MP3 music signals from a data bus, for example in a personal computer 28. The power line-to-audio equipment interface adapter 24 also includes a standard AC plug 34 for connection to a conventional 120 VAC receptacle 35 (FIG. 2). The power line-to-audio equipment interface adapter 22
10 may also include, for example, a pair of conventional stereo jacks 36 for connection to a conventional stereo system, generally identified with the reference numeral 38.

As mentioned above, a remote control unit 26 may be provided to facilitate control of the power line-to-audio equipment interface adapter 24 and of the data
15 source player functions. The remote control unit 26 may be a conventional infrared remote control device. Such infrared remote control devices are extremely well known in the art, for example, as disclosed in U.S. Patent No. 5,845,151. Control signals transmitted from the remote control unit 26 are received by a remote control receiver in the power line-to-audio equipment
20 interface adapter 24. A control signal modulator in the power line-to-audio equipment interface adapter 24 transmits a modulated signal representing the control signals received from the remote control unit 26 over the power lines in the same manner as the audio signals. Thus, the data source player, provided by a personal computer in which the data bus is located, can be controlled from a
25 remote location.

A block diagram of the data bus-to-power line interface adapter 22 is illustrated in FIG. 2. The data bus-to-power line interface adapter 22 includes a coupling circuit 44. Such coupling circuits 44 are extremely well known in the art, for example, as disclosed in U.S. Patent Nos. 4,004,110 and 5,559,377,
30 hereby incorporated by reference. Such coupling circuits 44 are known to be impedance matched to the power line network to minimize power losses. In general, such coupling circuits include a transformer for impedance matching and may also include a surge suppressor for protecting the circuit from voltage spikes. A suitable surge suppressor is model SAC 6.0, available from General
35 Semiconductor.

A transceiver 52 is provided which modulates the data signals onto the power line network. Such transceivers are extremely well known in the art. A suitable transceiver is model no. AN 10M, available from Adaptive Networks.

An AC power supply 46 is also provided. The AC power supply 46 converts the power line network voltage to, for example, 6 volts DC, suitable for powering the data bus-to-power line interface adapter 22. Such AC power supplies are also well known in the art.

5 Audio signals from the data bus, such as streaming MP3 music data, received through, for example, the USB connector 32 over the USB cable 30 from the USB port in a personal computer 28, is applied to, for example, a USB circuit 48. The USB circuit 48 may include a USB controller (not shown) as well as data buffers for buffering the streaming MP3 digital audio data. USB controllers
10 are extremely well known in the art as discussed above. The USB circuit 48 is under the control of a microprocessor 50, for example, a 32-bit RISC architecture, model number ARM7TDMI, for example, available from Advanced RISC Machines of Cambridge, United Kingdom. Other microprocessors as well as digital signal processors are also suitable. The microprocessor 50, converts, for
15 example, the serial USB data into a packet protocol suitable for transmission by the transceiver 52. A 128 kbyte random access memory (RAM) may be provided for assembling the data packets for the transceiver 52. As the serial data, for example; from the data bus on the PC 28, is converted by the microprocessor 50, the packets are temporarily stored in the memory 54 before transmission by the
20 transceiver 52.

 The data packets are applied to the transceiver 52 by way of a cable 53. The modulated digital data is then transmitted over the power line network under the control of the transceiver 52. Any conventional data packet addressing
25 protocol may be used to provide peer-to-peer or broadcast capabilities permitting one or more data source player to supply audio files to one or more audio playback devices. The system may be configured to provide 1.5 megabits per second throughput of the audio signal data received by the power line-to-audio equipment interface adapter 24, illustrated in FIG. 3.

 The power line-to-audio equipment interface adapter 24 includes a
30 conventional AC plug 34, adapted to be plugged into a standard 120-volt receptacle 36. Similar to the data bus-to-power line interface adapter 22, the power line-to-audio equipment adapter 24 also includes a coupling circuit 56 and an AC power supply 58, connected to the 120-volt plug 34. The power line-to-audio equipment interface adapter 24 also includes a data signal transceiver 59, for
35 example, model AN10M available from Adaptive Networks. The power supply 58 converts the 120 VAC to supply voltages for the analog and digital circuits in the power line-to-audio equipment interface adapter 24. The data is received by the coupling circuit 56 and demodulated by the transceiver 59. The

microprocessor 60, similar to the microprocessor 50, as well as the random access memory (RAM) 62, are used to convert the data packets from the transceiver 59 to a protocol suitable for use with a data bus on the receiver side, for example, a VS bus 64, which, in turn, may be decoded to provide signals compatible with the audio equipment by, for example, an MP3 audio decoder 66, coupled to the VS bus 64.

The MP3 audio decoder 66 may be an MPEG 2.5 layer 111 decoder, for example, model number STA0013 manufactured by SGS Thomson. The output of the MP3 audio decoder 66 may be applied to an audio digital to analog converter (DAC), for example, Model No. CS4331 audio DAC, manufactured by Cirrus Logic. The audio DAC 68 may be used, for example, to provide left and right output stereo signals AOUTL and AOUTR 36, which are adapted to be connected with the users existing stereo equipment 38.

In addition, as discussed above, a remote control receiver, such as infrared transceiver 70, may be optionally provided. The infrared transceiver 70 may be connected to the microprocessor 60 to enable the power line-to-audio equipment interface adapter 24 and data source to be controlled by a the infrared remote 26 (FIG. 1). Such infrared transceivers 70 and infrared remote control devices 26 are extremely well known in the art as discussed in U.S. Patent No. 5,845,151. The control signals received by infrared transceiver 70 are modulated by transceiver 59 and transmitted over the power lines via coupling circuits 56. At the data bus-to-power line interface 22, transceiver 52 demodulates the control signals and supplies the control signals to microprocessor 50, so that the source player provided by PC 28 can be controlled.

The many features and advantages of the invention are apparent from the detailed specification and, thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

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CLAIMS

What is claimed is:

1. An audio file transfer system to transfer audio files from a data bus to audio output equipment over power lines supplying electricity to the audio output equipment, comprising:

5 at least one data bus-to-power line interface adapter to receive the audio files from the data bus and to transmit over the power lines a first modulated signal representing the audio files; and

 at least one power line-to-audio equipment interface adapter to decode the first modulated signal on the power line network and to generate audio signals compatible with the audio output equipment.

2. An audio file transfer system as recited in claim 1, wherein said audio file transfer system is capable of being controlled by a remote control unit,

 wherein said power line-to-audio equipment interface adapter includes

5 a remote control receiver to receive control signals from the remote control unit; and

 a first transceiver to transmit over the power lines a second modulated signal representing the control signals received from the remote control unit, and

10 wherein said data bus-to-power line interface adapter includes a second transceiver to demodulate the second modulated signal.

3. An audio file transfer system as recited in claim 1, wherein said audio file transfer system includes a plurality of data bus-to-power line interface adapters, each providing audio files to said at least one power line-to-audio equipment interface adapter.

4. An audio file transfer system as recited in claim 1, wherein said audio file transfer system includes a plurality of power line-to-audio equipment interface adapters, each capable of receiving the audio files from said at least one data bus-to-power line interface adapter.

5. An audio file transfer system as recited in claim 1, wherein each power line-to-audio equipment interface adapter is separately addressed by the at least one data bus-to-power line interface adapter.

6. An audio file transfer system as recited in claim 5, wherein said audio file transfer system includes a plurality of data bus-to-power line interface adapters, each providing audio files to at least one of said power line-to-audio equipment interface adapters.

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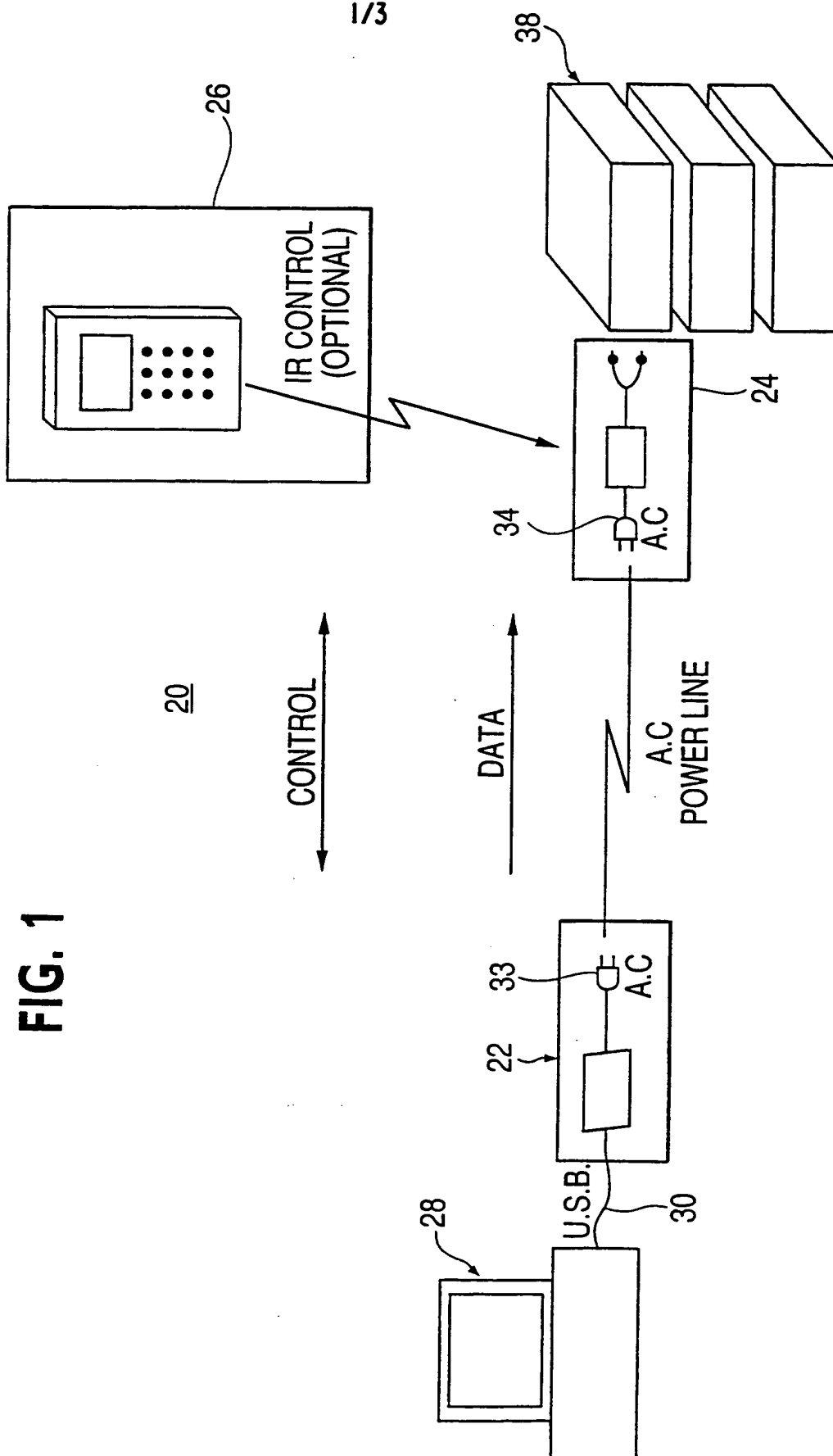
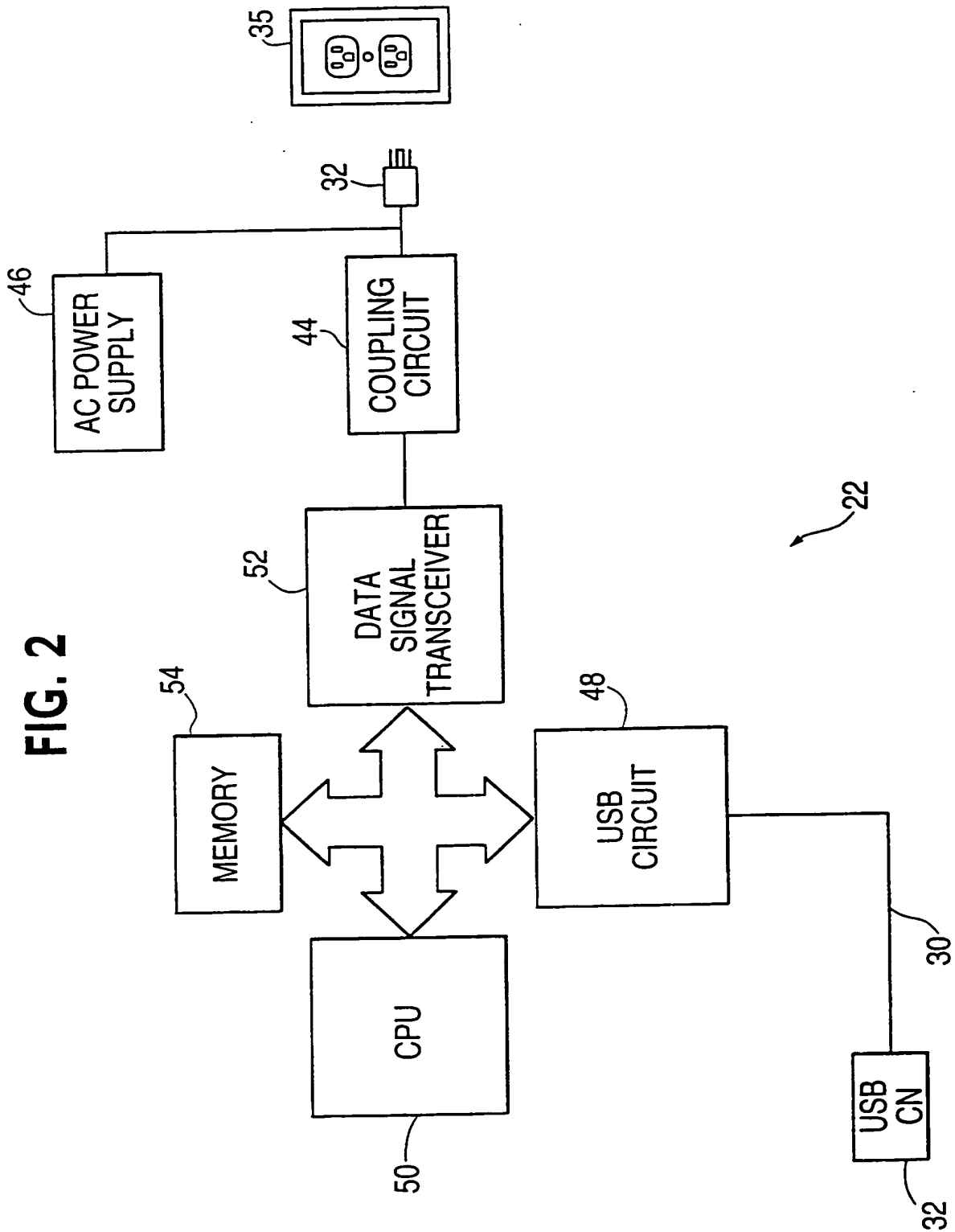
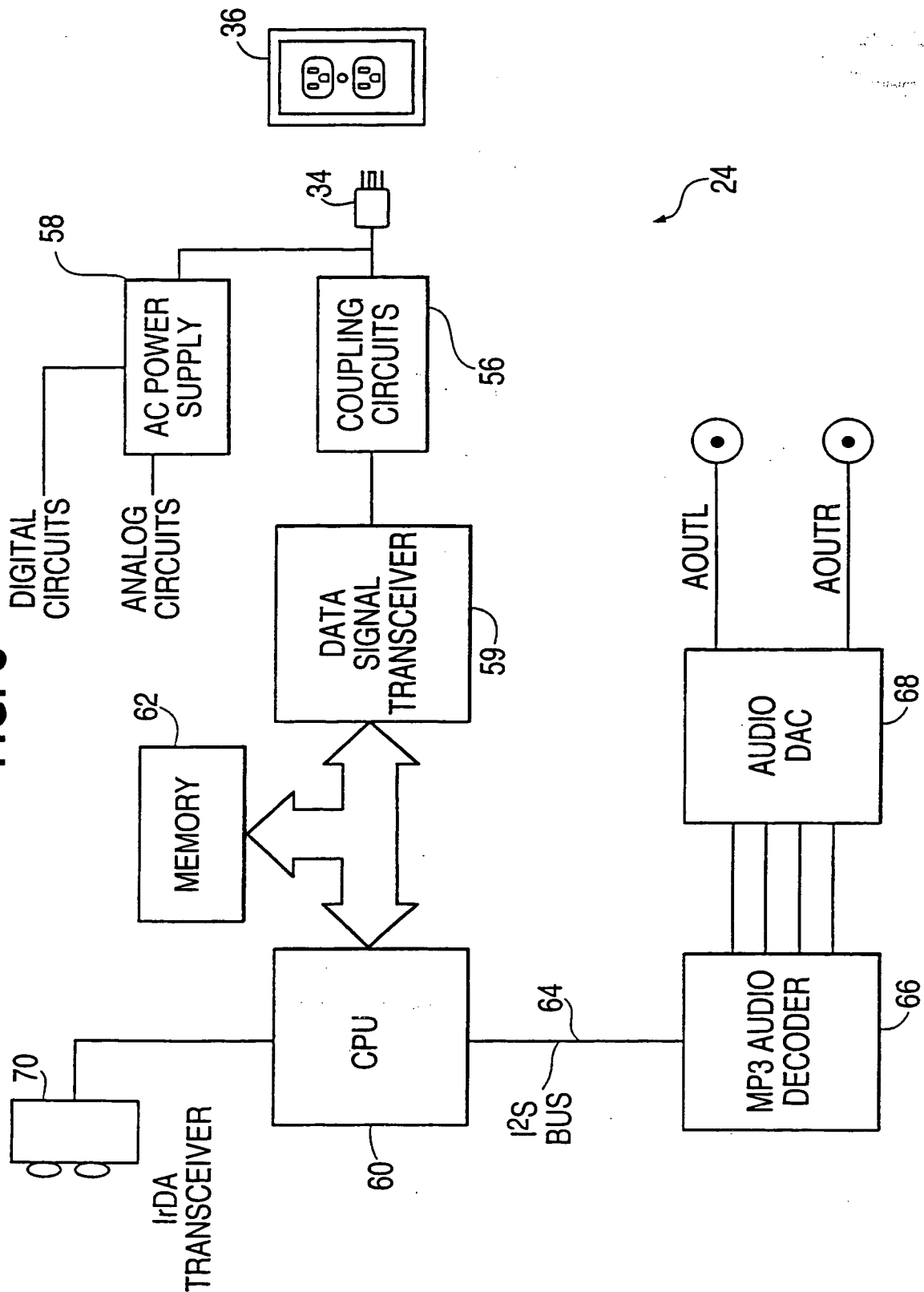


FIG. 1



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FIG. 3



INTERNATIONAL SEARCH REPORT

Intern. Application No.

PCT/US 00/29195

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H04B3/54 H04R5/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| X | EP 0 909 112 A (TOUCHTUNES MUSIC CORP) 14 April 1999 (1999-04-14) column 3, line 28 -column 4, line 14; figure 1 column 4, line 54 -column 5, line 18; figure 1 | 1-6 |
| A | WO 97 23056 A (ELCOM TECH CORP) 26 June 1997 (1997-06-26) page 1, line 16 -page 2, line 11 | 1-6 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| EP 0909112 A | 14-04-1999 | FR 2769165 A | 02-04-1999 |
| | | CA 2249071 A | 26-03-1999 |
| | | JP 11163813 A | 18-06-1999 |
| WO 9723056 A | 26-06-1997 | AU 1294897 A | 14-07-1997 |